2.2 Two Approaches To Network Communication

Whether they provide connections between one computer and another or between a terminal and a computer, communication networks can be divided into two basic types: *connection-oriented* (sometimes called *circuit-switched*) and *connectionless* (sometimes called *packet-switched*†). Connection-oriented networks operate by forming a dedicated *connection* or *circuit* between two points. The U.S. telephone system uses a connection-oriented technology — a telephone call establishes a connection from the originating phone through the local switching office, across trunk lines, to a remote switching office, and finally to the destination telephone. While a connection is in place, the phone equipment samples the microphone repeatedly, encodes the samples digitally, and transmits them across the connection to the receiver. The sender is guaranteed that the samples can be delivered and reproduced because the connection provides a guaranteed data path of 64 Kbps (thousand bits per second), the rate needed to send digitized voice. The advantage of connection-oriented networking lies in its guaranteed capacity: once a circuit is established, no other network activity will decrease the capacity of that circuit. One disadvantage of connection-oriented technology arises from cost: circuit costs are fixed, independent of use. For example, one pays a fixed rate for a phone call, even when the two parties do not talk.

Connectionless networks, the type often used to connect computers, take an entirely different approach. In a connectionless network, data to be transferred across a network is divided into small pieces called *packets* that are multiplexed onto high capacity intermachine connections. A packet, which usually contains only a few hundred bytes of data, carries identification that enables the network hardware to know how to send it to the specified destination. For example, a large file to be transmitted between two machines must be broken into many packets that are sent across the network one at a time. The network hardware delivers the packets to the specified destination, where software reassembles them into a single file again. The chief advantage of packet-switching is that multiple communications among computers can proceed concurrently, with intermachine connections shared by all pairs of computers that are communicating. The disadvantage, of course, is that as activity increases, a given pair of communicating computers receives less of the network capacity. That is, whenever a packet switched network becomes overloaded, computers using the network must wait before they can send additional packets.

Despite the potential drawback of not being able to guarantee network capacity, connectionless networks have become extremely popular. The motivations for adopting packet switching are cost and performance. Because multiple computers can share the network bandwidth, fewer connections are required and cost is kept low. Because engineers have been able to build high speed network hardware, capacity is not usually a problem. So many computer interconnections use connectionless networks that, throughout the remainder of this text, we will assume the term *network* refers to a connectionless network unless otherwise stated.

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†In fact, it is possible to build hybrid hardware technologies; for our purposes, only the difference in functionality is important.